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*Research Paper*

# Computer Vision Based Face Mask and Safety Gear Detection

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***ABSTRACT-*** ***This paper presents a Computer Vision Based Face Mask and Safety Gear Detection System that utilizes Artificial Intelligence (AI) and Deep Learning techniques to automatically detect whether individuals are wearing face masks through real-time video captured from a webcam. The primary objective of the proposed system is to improve safety compliance by reducing the dependence on manual monitoring in workplaces, hospitals, educational institutions, industries, and public places. Traditional face mask monitoring methods rely on human observation, which is time-consuming, labor-intensive, prone to errors, and inefficient in crowded environments. To overcome these limitations, the proposed system performs automated real-time detection with high accuracy and minimal human intervention. The system is developed using Python, Flask, OpenCV, TensorFlow, Keras, HTML, CSS, and JavaScript. OpenCV is used for image acquisition and face detection, while a pre-trained MobileNetV2 deep learning algorithm is employed to classify each detected face as Mask or No Mask. Flask provides a web-based interface that enables users to access the application and view live detection results. The processed video stream displays prediction labels and confidence scores for each detected face, allowing instant monitoring and decision-making. The proposed system offers fast processing speed, reliable performance, and cost-effective deployment.***

***KEYWORDS:*** ***Computer Vision, Face Mask Detection, Deep Learning, MobileNetV2, OpenCV, TensorFlow, Flask,***

***Artificial Intelligence, Personal Protective Equipment (PPE)***

## INTRODUCTION

Computer Vision is a rapidly growing field of Artificial Intelligence (AI) that enables computers to analyze, interpret, and understand digital images and videos in a manner similar to human vision. It has found wide applications in healthcare, industrial automation, surveillance, transportation, and workplace safety. One of its important applications is the automatic detection of face masks and safety gear to ensure compliance with safety regulations and reduce the risk of accidents and the spread of infectious diseases. Traditional monitoring methods rely on manual observation, which is time-consuming, labor-intensive, and prone to human errors, particularly in crowded environments. To address these challenges, this paper proposes a Computer Vision Based Face Mask and Safety Gear Detection System that performs real-time face mask detection using Deep Learning techniques. The system is developed using Python, Flask, OpenCV, TensorFlow, Keras, HTML, CSS, and JavaScript. Live video is captured through a webcam, where the OpenCV DNN Face Detector identifies human faces, and a pre-trained MobileNetV2 model classifies each detected face as Mask or No Mask. The Flask framework provides a user-friendly web interface for real-time monitoring and visualization of detection results with confidence scores. The proposed system offers high accuracy, fast processing, low deployment cost, and minimal human intervention, making it suitable for deployment in hospitals, educational institutions, industries, offices, and other public places. Furthermore, the system can be extended to detect additional Personal Protective Equipment (PPE), such as helmets, safety goggles, gloves, and reflective jackets, for comprehensive workplace safety monitoring

## Related Work

Computer Vision and Deep Learning have significantly advanced automated face mask detection systems, enabling accurate and real-time monitoring in various public and workplace environments. Several researchers have proposed intelligent approaches using convolutional neural networks (CNNs) and transfer learning models to improve detection accuracy and processing speed. Loey et al. developed a hybrid deep transfer learning model combined with machine learning techniques for face mask detection, demonstrating high classification accuracy on different datasets. Chavda et al. proposed a multi-stage CNN architecture that effectively detects masked and unmasked faces under varying lighting and pose conditions. Anggraini et al. implemented a lightweight SSDLite MobileNetV3 model on Raspberry Pi, showing that real-time face mask detection can be achieved even on low-cost embedded devices. Soumya et al. introduced a modified YOLO-based approach that improved object detection speed while maintaining reliable mask detection performance. Similarly, Nithin and Jaisharma presented an enhanced SSD-based deep learning model that achieved better prediction accuracy compared to conventional CNN methods. Although these approaches provide promising results, some require high computational resources or specialized hardware for deployment. The proposed Computer Vision Based Face Mask and Safety Gear Detection System addresses these challenges by using the OpenCV DNN Face Detector together with the MobileNetV2 deep learning model, providing an efficient, accurate, and cost-effective solution for real-time face mask detection through a Flask-based web application suitable for educational institutions, industries, hospitals, and other public environments.

## LITERATURE SURVEY

Computer Vision and Deep Learning have become essential technologies for developing intelligent face mask detection systems that improve public safety and workplace monitoring. In 2021, Loey et al. proposed a hybrid deep transfer learning model combined with machine learning techniques for automatic face mask detection. Their approach achieved high classification accuracy by utilizing transfer learning, making it suitable for real-time applications. Chavda et al. (2021) developed a multi-stage Convolutional Neural Network (CNN) architecture capable of detecting masked and unmasked faces under different lighting conditions and facial orientations. In 2022, Anggraini et al. introduced a lightweight face mask detection system using the SSDLite MobileNetV3 model on Raspberry Pi, demonstrating efficient performance on low-cost embedded devices. Soumya et al. (2022) presented a modified YOLO-based model that improved real-time detection speed while maintaining reliable accuracy. Similarly, Nithin and Jaisharma (2022) proposed an enhanced Single Shot Detector (SSD)-based deep learning model that provided better prediction accuracy than conventional CNN models. Although these studies achieved promising results, some required complex model architectures or higher computational resources. The proposed Computer Vision Based Face Mask and Safety Gear Detection System utilizes the OpenCV

DNN Face Detector together with the MobileNetV2 deep learning model to provide an accurate, efficient, and user-friendly real-time detection.

## EXISTING METHOD

Loey et al. (2021) proposed a hybrid deep transfer learning model integrated with machine learning techniques for automatic face mask detection during the COVID-19 pandemic. The system employed pre-trained deep learning models to extract facial features, while machine learning classifiers were used to classify images into two categories: Mask and No Mask. The proposed approach achieved high classification accuracy on publicly available datasets and demonstrated the effectiveness of transfer learning in reducing training time compared to conventional deep learning models. However, the existing system was primarily designed for image-based dataset evaluation rather than continuous real-time monitoring. It required significant computational resources during model training and did not provide a user-friendly web interface for practical deployment. Moreover, the system lacked seamless integration with live webcam video streaming, limiting its application in real-world environments such as hospitals, industries, educational institutions, and public places. To overcome these limitations, the proposed Computer Vision Based Face Mask and Safety Gear Detection System utilizes the OpenCV DNN Face Detector along with the MobileNetV2 deep learning model to perform real-time face mask detection using a live webcam. The system is integrated with a Flask-based web application that provides continuous monitoring, real-time prediction with confidence scores, faster processing, and an easy-to-use interface, making it more suitable for practical safety monitoring applications.

## PROPOSED SYSTEM

The existing face mask detection systems are capable of identifying whether a person is wearing a face mask; however, many of them are designed primarily for offline image classification or require high computational resources for training and deployment. Some existing methods lack real-time video processing capabilities, provide limited user interaction, and are not integrated with a web-based interface for practical use. These limitations reduce their effectiveness in crowded environments where continuous monitoring and instant detection are required. To address these issues, the proposed Computer Vision Based Face Mask and Safety Gear Detection System is designed to perform accurate and real-time face mask detection using a live webcam. The system is developed using Python, Flask, OpenCV, TensorFlow, Keras, HTML, CSS, and JavaScript. OpenCV is used to capture and process live video frames, while the OpenCV DNN Face Detector identifies human faces. A pre-trained MobileNetV2 deep learning model classifies each detected face as Mask or No Mask with high accuracy. The Flask framework provides a simple and interactive web interface that enables users to start, stop, and monitor the detection process in real time. The proposed system offers faster processing, improved usability, low deployment cost, and continuous monitoring, making it suitable for hospitals, educational institutions, industries, offices, and other public environments. Furthermore, the modular architecture allows future integration of additional Personal Protective Equipment (PPE) detection, such as helmets, safety goggles, gloves, and reflective jackets.

## SYSTEM ARCHITECTURE

The architecture of the proposed Fake Social Media Account Detection System consists of a user interface, feature extraction module, Machine Learning model, dataset, and prediction module. The user enters social media account details through the web interface, and the feature extraction module processes the input data by extracting relevant profile features such as profile picture availability, username, biography, number of posts, followers, following count, account privacy, and follower-following ratio. The extracted features are then passed to the trained Machine Learning model for analysis and classification. Based on the prediction result, the system determines whether the account is genuine or fake and displays the result to the user. This architecture provides an intelligent, accurate, and real-time solution for detecting fake social media accounts while improving the security and trustworthiness of social networking platforms.

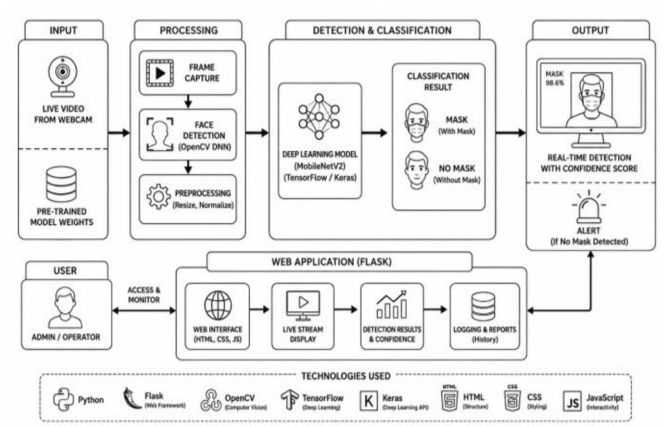


**Fig 1: System Architecture**

## METHODLOGY DESCRIPTION

The proposed Computer Vision Based Face Mask and Safety Gear Detection System follows a sequence of modules to perform accurate and real-time face mask detection. Each module contributes to capturing, processing, analyzing, and displaying the detection results efficiently.

## 1. Input Module

The input module captures live video continuously through a webcam. The captured video is divided into individual frames, which are supplied to the processing module for face detection and further analysis.

## 2. Frame Processing Module

This module processes each captured video frame by resizing, normalizing, and converting it into a suitable format. Image preprocessing improves detection accuracy and prepares the frames for deep learning-based analysis.

## 3. Face Detection Module

The face detection module utilizes the OpenCV Deep Neural Network (DNN) Face Detector to identify human faces from the processed video frames. Only the detected facial regions are forwarded for mask classification.

## 4. Face Mask Classification Module

The detected face images are analyzed using the pre-trained MobileNetV2 deep learning model developed with TensorFlow and Keras. The model classifies each face as either "Mask" or "No Mask" with a confidence score.

## 5. Result Visualization Module

The prediction results are displayed on the live video by drawing bounding boxes around detected faces along with labels and confidence scores. This enables users to monitor face mask compliance in real time.

## RESULTS AND DISCUSSION

The home page provides a simple interface with options to access the project information and start the real-time face mask detection process.


**Fig 2: Home Page of Fake Social Media Account Detection System**

The about page displays the project overview, technologies used, objectives, and applications of the Computer Vision Based Face Mask

Detection.

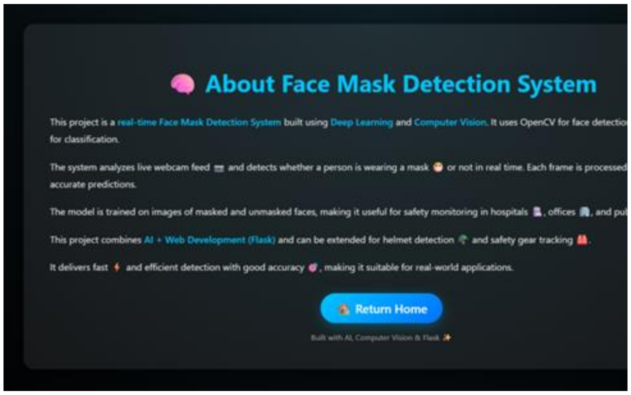


**Fig 3: About Page**

The detection interface provides controls to start, stop, restart the webcam, and return to the home page for easy user interaction.


**Fig 4: Detection Interface Page**

The system successfully detects a person wearing a face mask and displays a green bounding box with the prediction confidence score.


**Fig 5: Face Mask Detection Page**

The system identifies a person without a face mask and displays a red bounding box with the "No Mask" label and confidence score.

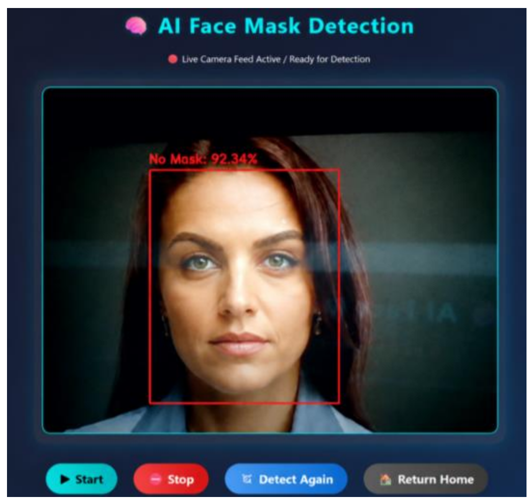


**Fig 6: Detection without mask page**

## CONCLUSION

The Computer Vision Based Face Mask and Safety Gear Detection System provides an efficient and intelligent solution for real-time face mask monitoring using Computer Vision and Deep Learning. The system is developed using Python, Flask, OpenCV, TensorFlow, Keras, and the MobileNetV2 model to accurately classify faces as Mask or No Mask through a live webcam. It offers a user-friendly web interface, fast processing, and reliable detection with confidence scores. The proposed system reduces manual monitoring efforts, improves public safety, and can be deployed in hospitals, educational institutions, industries, offices, and other public places. Its modular design also supports future enhancement for detecting additional safety gear such as helmets, gloves, and safety vests.

## FUTURE SCOPE

The proposed Computer Vision Based Face Mask and Safety Gear Detection System can be enhanced by integrating detection of additional Personal Protective Equipment (PPE) such as helmets, safety goggles, gloves, reflective jackets, and safety shoes. Future versions can support multiple camera surveillance, cloud-based data storage, and automated alert systems for safety violations. The system can also be integrated with IoT devices and smart surveillance systems for industrial safety monitoring. By adopting advanced deep learning models and edge computing, the application can achieve higher accuracy, faster processing, and large-scale deployment in industries, hospitals, construction sites, and other public environments.

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